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# BSC's potential contribution to C4MIP

....and some results too....

EC-Earth meeting October 2018

**Raffaele Bernardello**

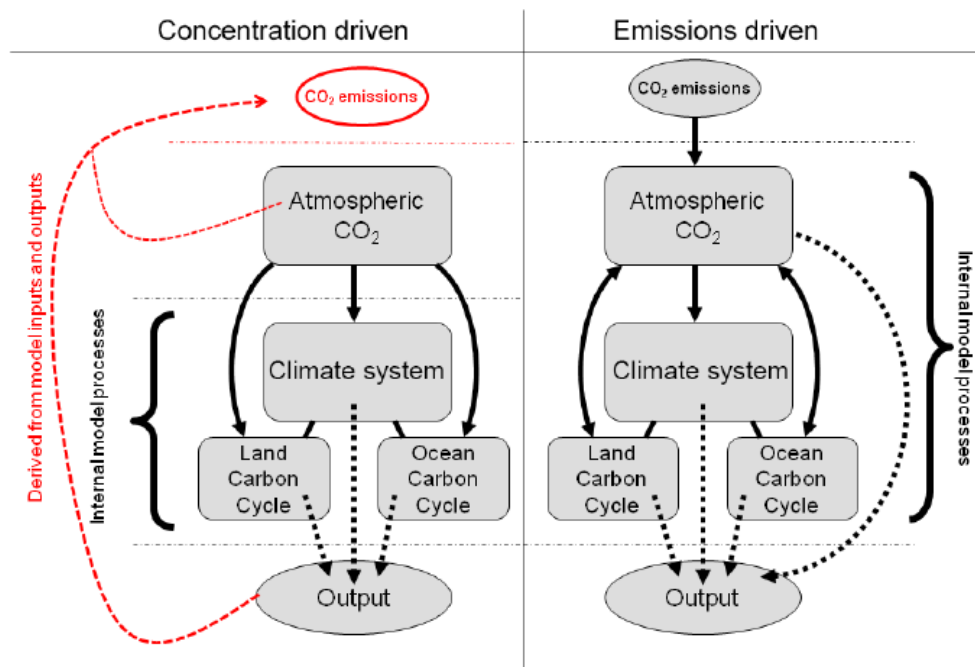
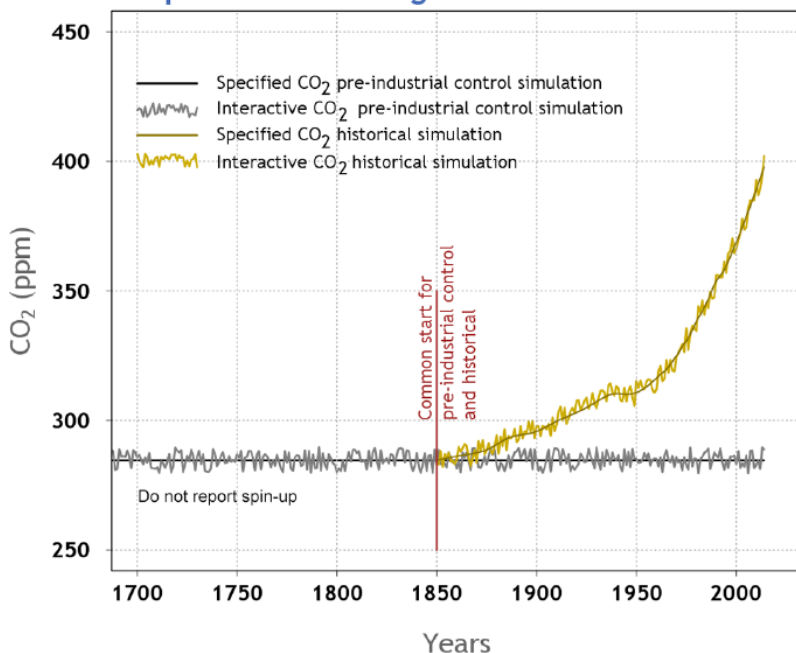
**Valentina Sicardi, Etienne Tourigny, Mario Acosta.**



## C4MIP – The Coupled Climate–Carbon Cycle Model Intercomparison Project: experimental protocol for CMIP6

Chris D. Jones et al. 2016 Geosci. Model Dev., 9, 2853–2880, 2016

Pre-industrial control run and spin-up  
prior to launching historical simulations



## DECK (CO2-concentration-driven)

- piControl (500 years)
- historical (165 years, 1850 - 2014)
- 1pctCO2 (141 years)

**EC-Earth + PISCES + LPJ-GUESS  
non-interactive mode (no TM5)**

**947 years**

## DECK (CO2 emission-driven)

- esm-piControl (500 years)
- ems-hist (165 years, 1850-2014)

## Tier 1

- 1pctCO2-bgc (141 years)
- esm-ssp585 (86 years, 2015-2100)

**EC-Earth-CC :  
IFS+NEMO+PISCES+LPJ-GUESS+TM5**

**751 years**

# Current performance on MN4



years/day

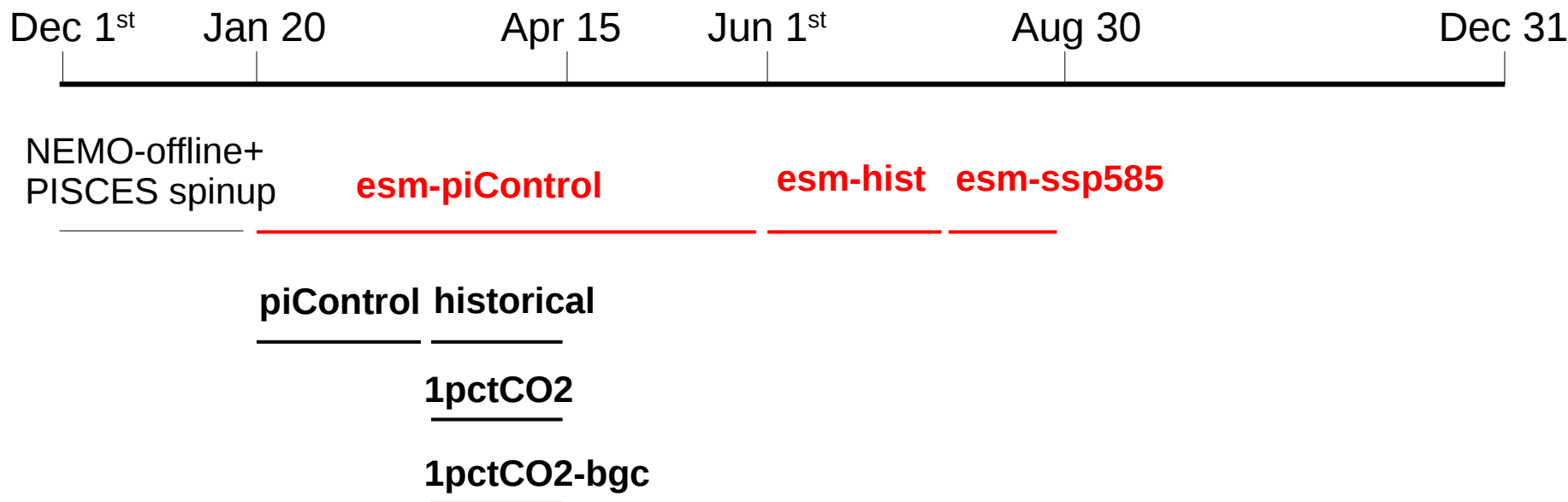
**IFS+NEMO+Runoff+XIOS** —————▶ **18**  
**(EC-Earth)**

**IFS+NEMO+Runoff+XIOS+PISCES** —————▶ **12**  
**(EC-Earth+PISCES)**

**IFS+NEMO+Runoff+XIOS+PISCES+LPJ-Guess** —————▶ **10(?)**  
**(EC-Earth-CC-noesm)**

**IFS+NEMO+Runoff+XIOS+PISCES+LPJ-GUESS+TM5** —————▶ **3.5**  
**(EC-Earth-CC)**

# Possible timeline



## Assuming that:

- 1- by Dec 1<sup>st</sup> spinup of EC-Earth completed (transport fields for offline)
- 2- everything goes well – i.e. no delays

# IPCC AR6 WG1 SCHEDULE



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**Cut off for results  
submission?**

**11 months from now.**  
**30<sup>th</sup> September 2019 ?**

**Cut off for literature  
submission is**  
**14 months from now**

## **Actions:**

- 1-Release CMIP6 version of EC-Earth
- 2- Extract transport fields from spinup for offline spinup of PISCES
- 3-Improve performance of EC-Earth-CC

## **What we are going to try over the next month:**

- 1-**Fields exchanged by TM5, will be grouped by interpolation type.
- 2-**Reduce the coupling frequency of TM5 (validation needed.)
- 3-**Test other interpolations (validation needed.)
- 4-**Use LUCIA to evaluate performance of single components when running in parallel.
- 5-**A profiling analysis using BSC Tools (Extrae and Paraver).



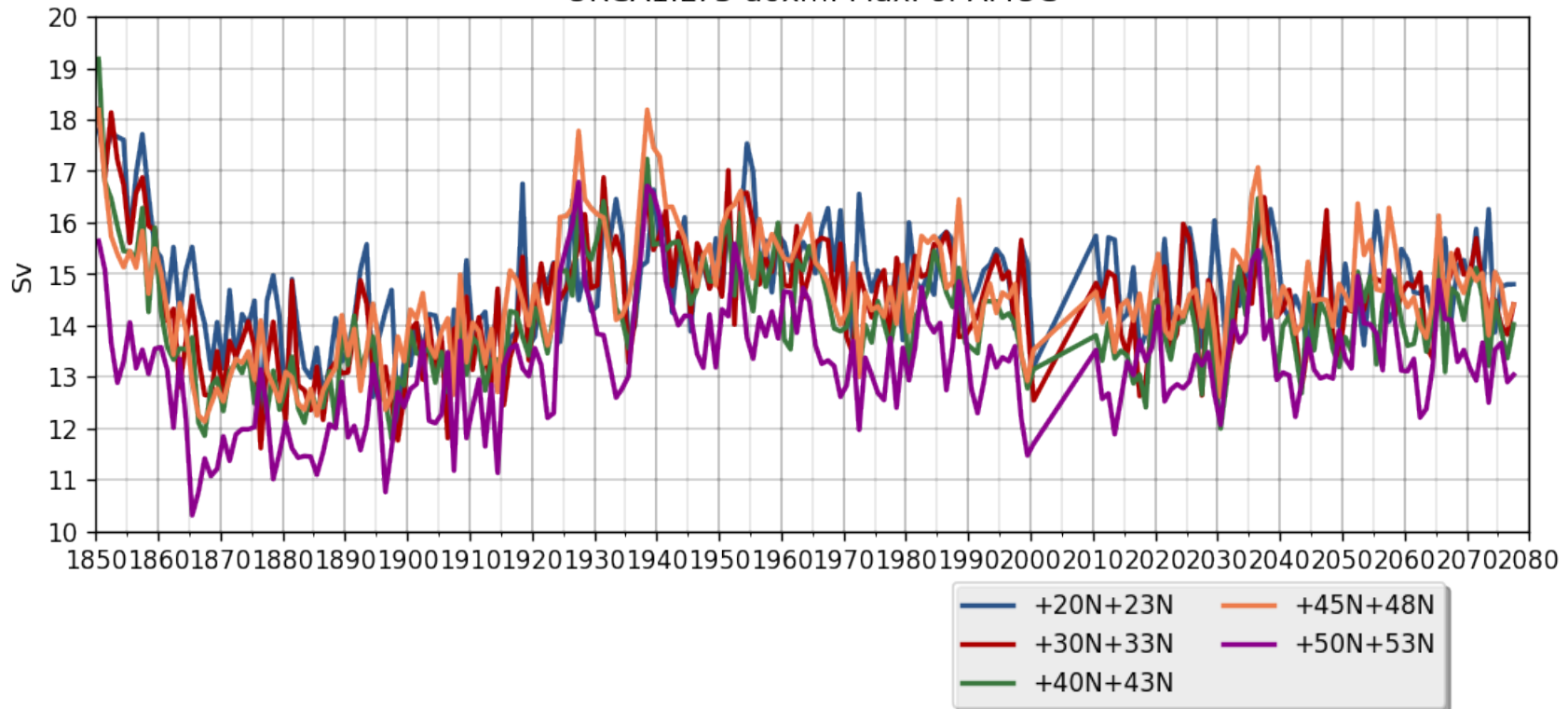
.....**The evolution of atmospheric CO<sub>2</sub> concentration can be simulated by assuming that CO<sub>2</sub> is completely well mixed** with the same globally averaged concentration everywhere in space or by transporting CO<sub>2</sub> as a three-dimensional tracer. This choice is up to the modelling groups.....

Geosci. Model Dev., 9, 2853–2880, 2016

**Ocean OK**

**Land not OK**

ORCA1.L75-a0xm: Max. of AMOC

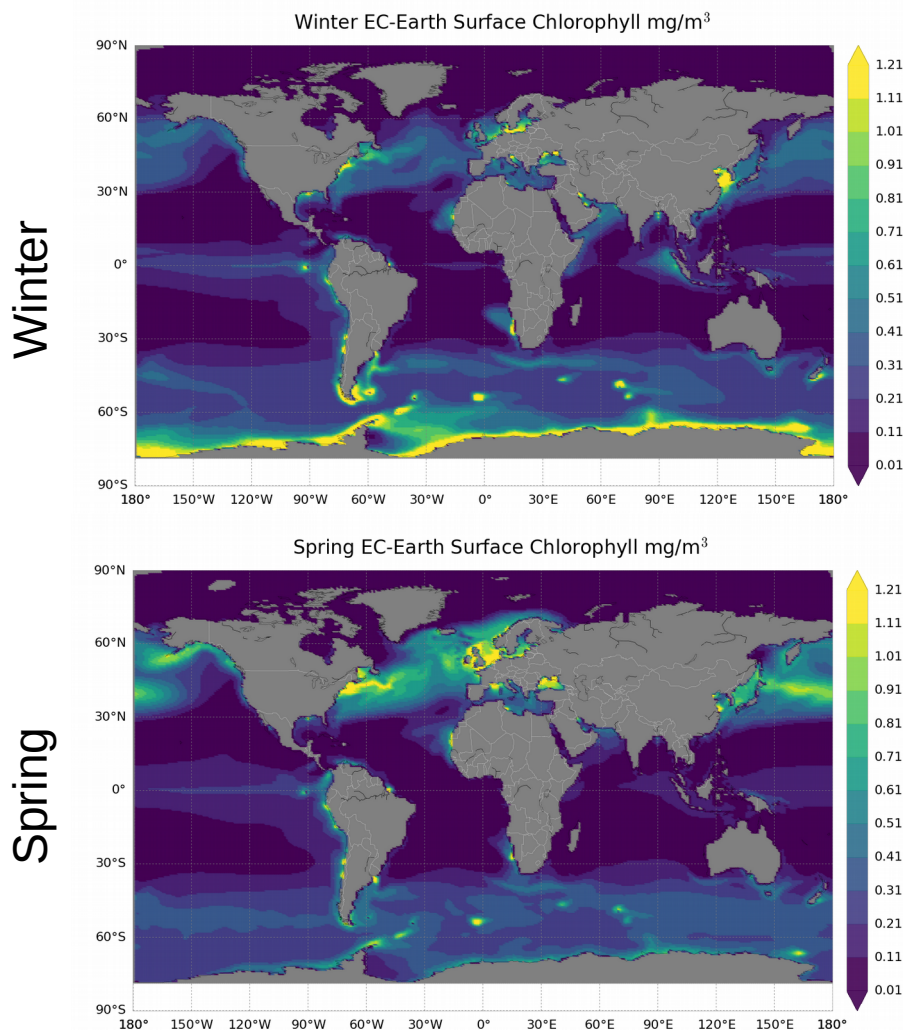


-250 years EC-Earth spinup (no PISCES)

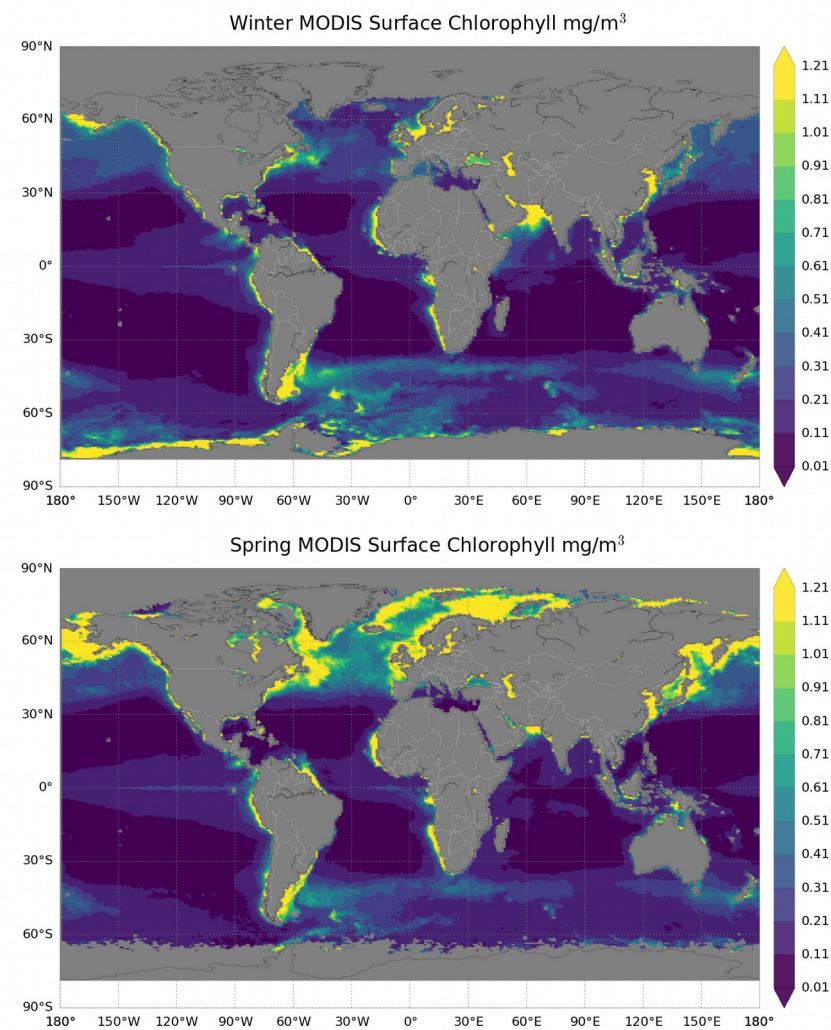
-2600 years NEMO-offline+PISCES spinup

-120 years EC-Earth+PISCES (preindustrial)

## EC-Earth



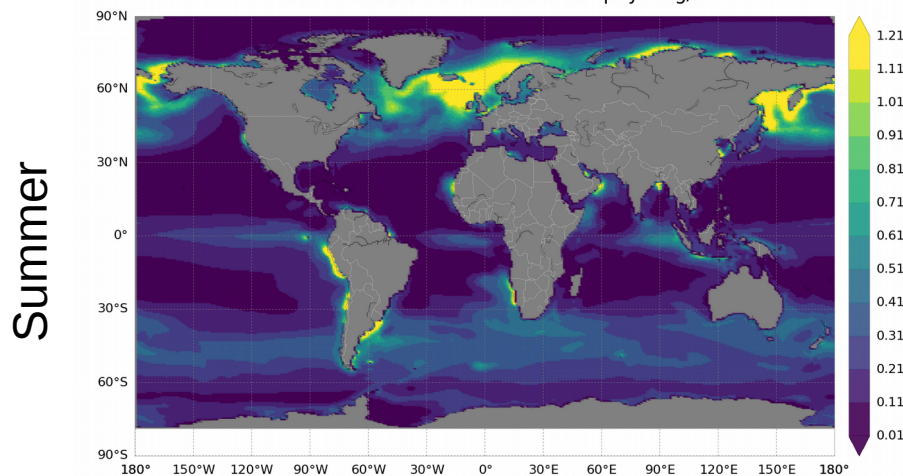
## MODIS-Aqua





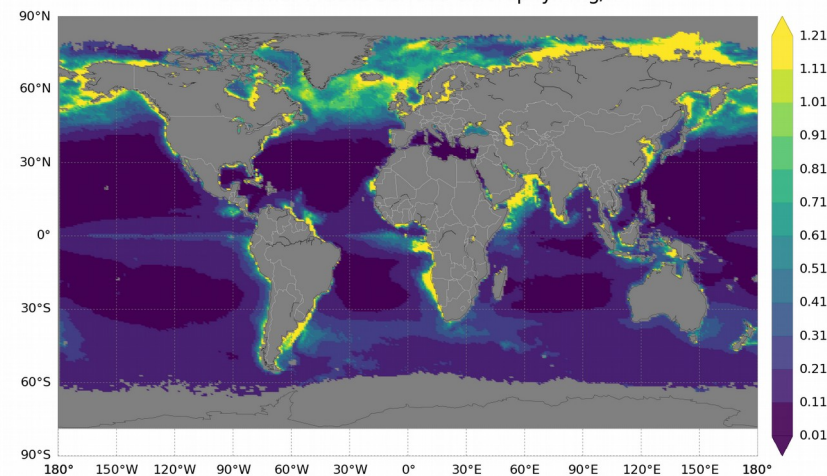
## EC-Earth

Summer EC-Earth Surface Chlorophyll  $\text{mg}/\text{m}^3$

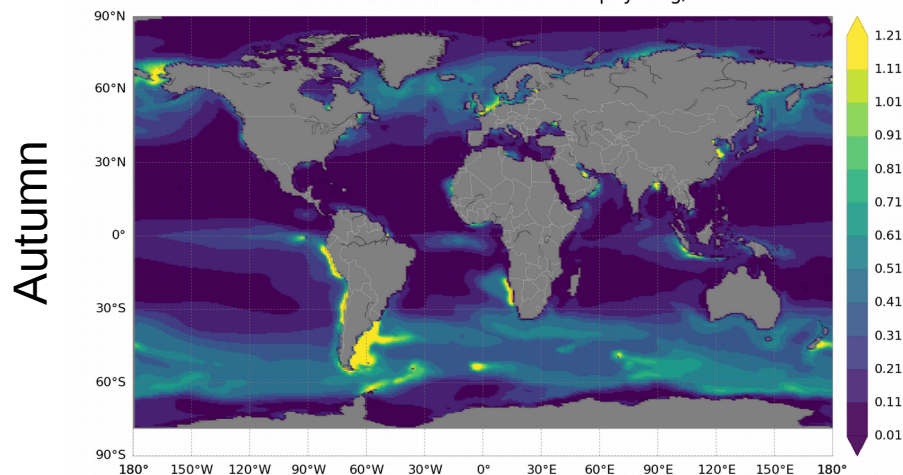


## MODIS-Aqua

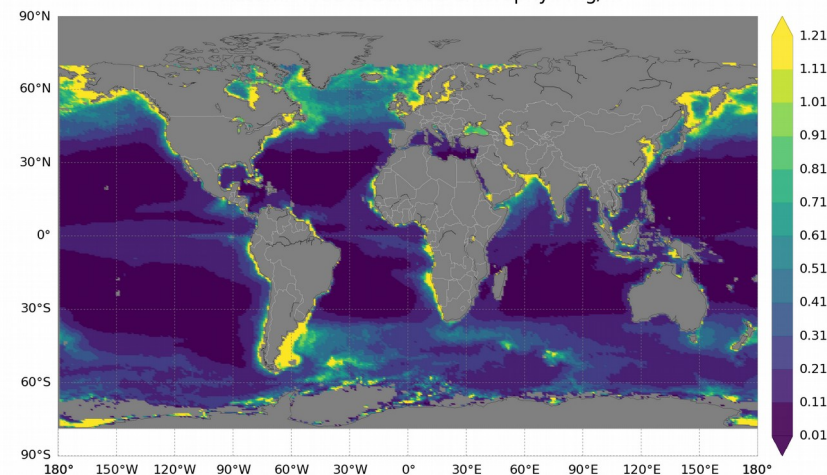
Summer MODIS Surface Chlorophyll  $\text{mg}/\text{m}^3$



Autumn EC-Earth Surface Chlorophyll  $\text{mg}/\text{m}^3$



Autumn MODIS Surface Chlorophyll  $\text{mg}/\text{m}^3$



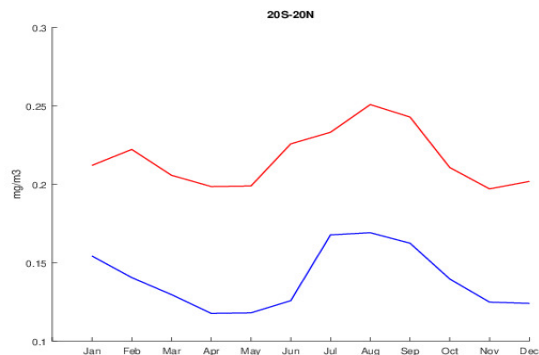
# Monthly Surface Chlorophyll $\text{mg}/\text{m}^3$



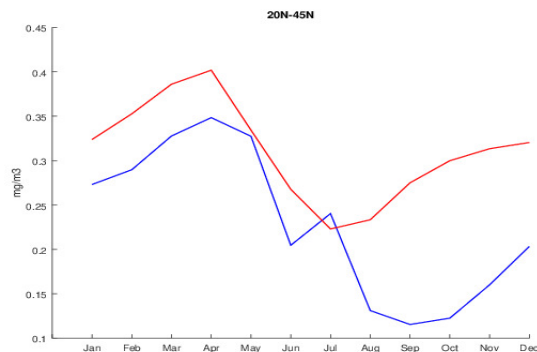
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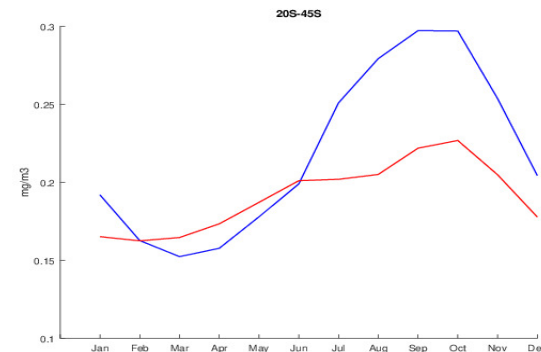
## 20°S - 20°N



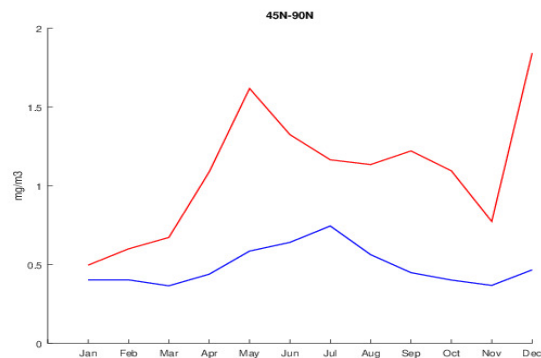
## 20°N - 45°N



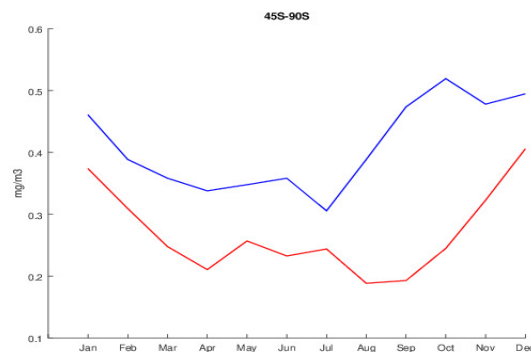
## 20°S - 45°S



## 45°N - 90°N



## 45°S - 90°S



EC-Earth  
MODIS-a

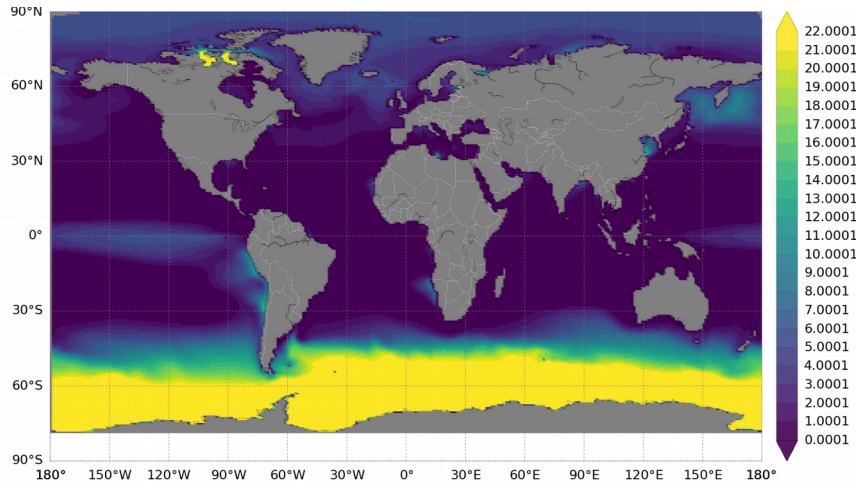
# Year-av. Surface Nitrate mmol/m<sup>3</sup>



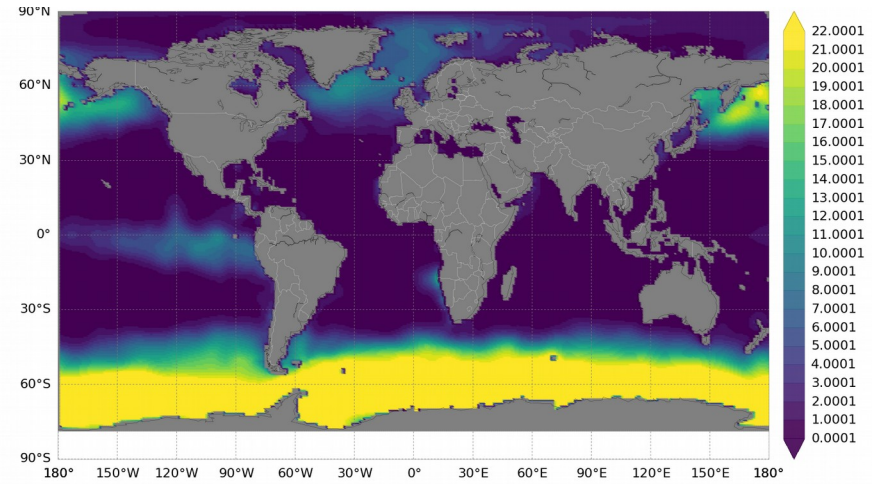
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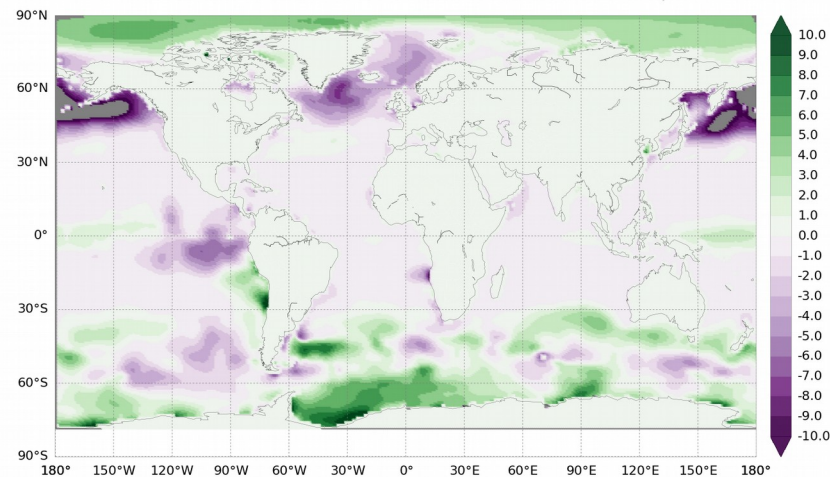
## EC-Earth



## WOA13



## Year-av. ECEarth - WOA13 Surface Nitrate bias mmol/m<sup>3</sup>





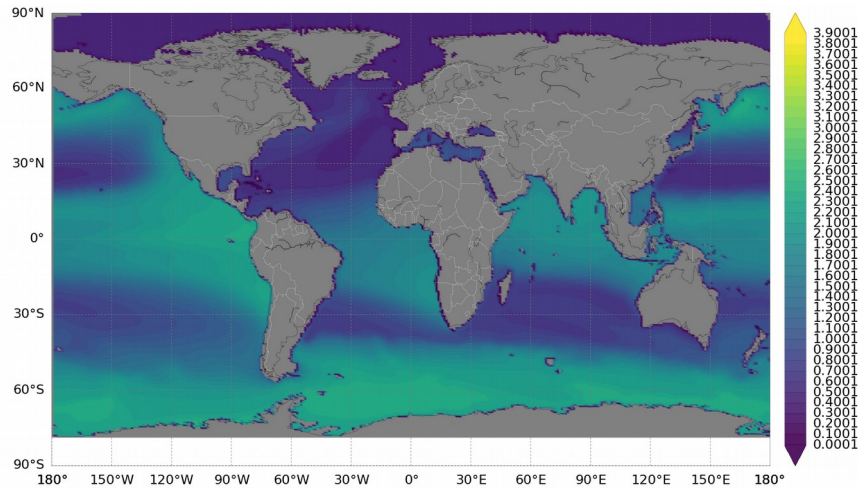
# Year-av. 500m Phosphate mmol/m<sup>3</sup>



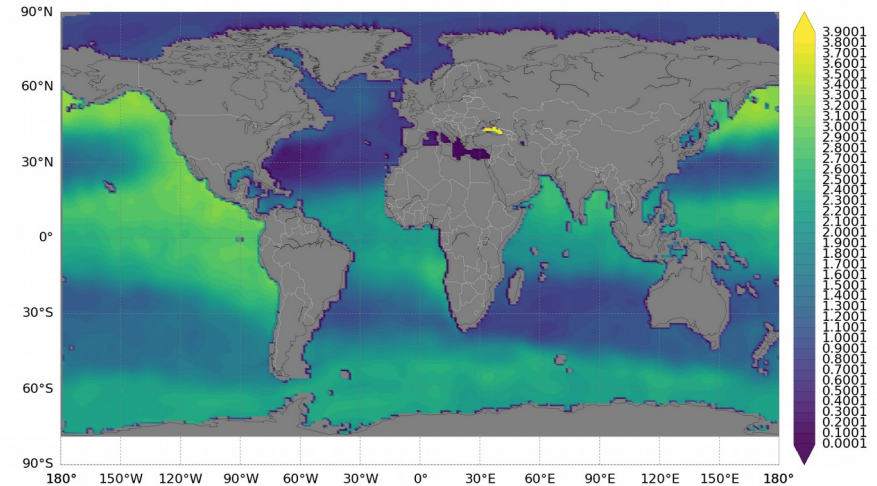
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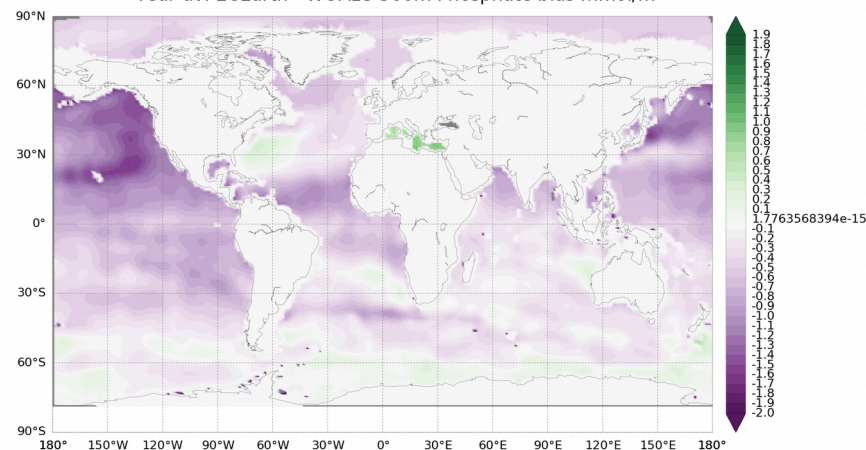
## EC-Earth



## WOA13



## Year-av. ECEarth - WOA13 500m Phosphate bias mmol/m<sup>3</sup>

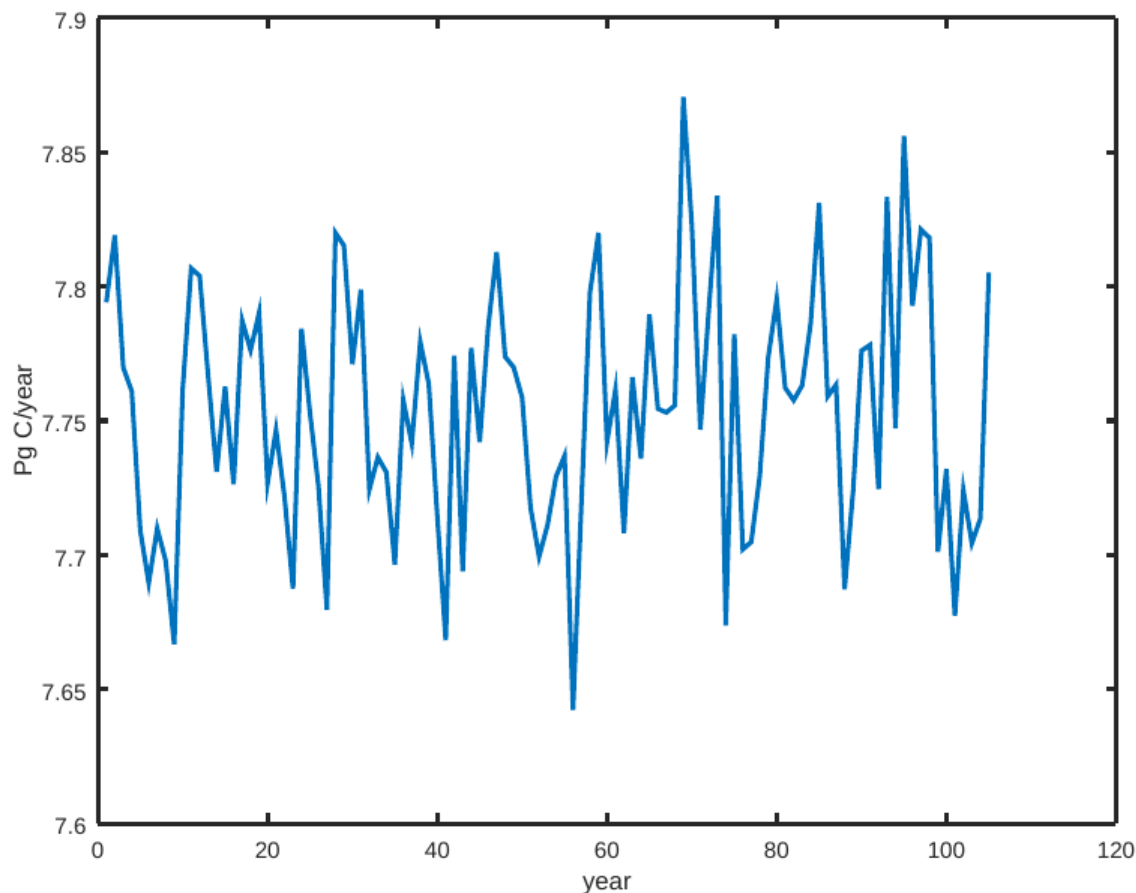


# Export production at 100m Pg C/year



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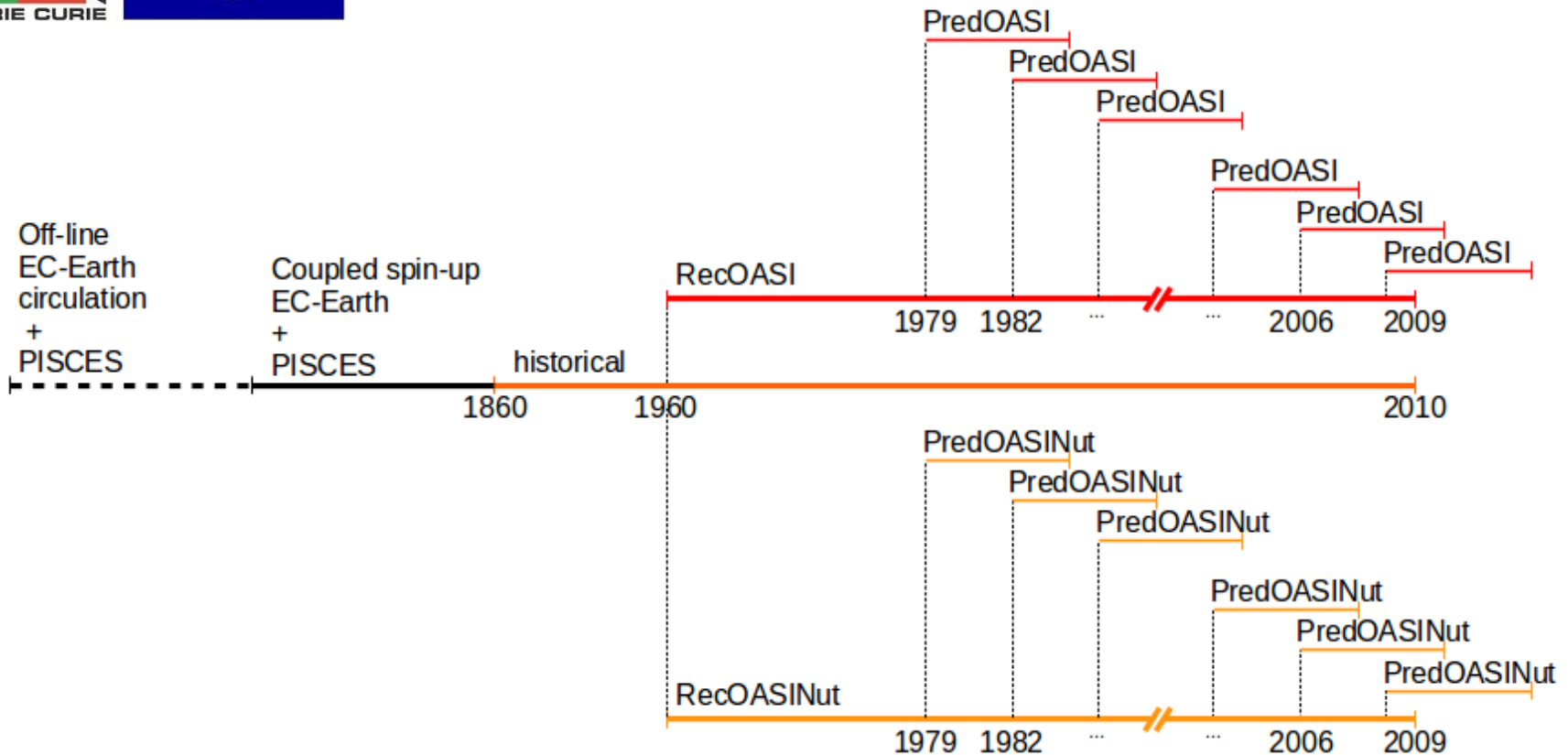
Estimates from obs:

Between 4-12 Pg C/year

e.g. Henson et al. 2011  
Dunne et al. 2007



## Near-term Predictability of Net Primary Production in the Atlantic Ocean



- Improving EC-Earth-CC performance is high priority action for C4MIP participation
- Need to clearly plan who is going to do what on which machine
- Pre-tuning version provides ocean dynamics resulting in realistic ocean biogeochemistry
- Ready to perform planned experiments on decadal ocean bgc predictions